Initial results on multi event analysis of the simultaneous observation of isolated proton auroras at subauroral latitudes by a highly sensitive all-sky camera and the Van Allen Probes satellites

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Isolated proton aurora (IPA) appears at subauroral latitudes with Pc1 geomagnetic pulsations. This aurora has a spot-like feature extending in the east-west direction. Proton aurora is caused by energetic proton precipitating from the magnetosphere through charge-exchange collisions with atmospheric particles in the ionosphere. Previous studies suggested that IPA is caused by electromagnetic ion cyclotron (EMIC) waves which scatter pitch angle of energetic protons into the loss cone in the magnetosphere and making their precipitation into the ionosphere. EMIC waves are considered to make rapid loss of the radiation belt electrons into the atmosphere through wave-particle interaction. The IPA is the projection of the wave-particle interaction region into the ionosphere. Thus, simultaneous observation of magnetospheric EMIC waves and IPA is important to understand the scale sizes of the wave-particle interaction region. There have been few observation of IPA and its magnetospheric source region except for Nishimura et al. [JGR, 2014; doi: 10.1002/2014JA020029] and Nakamura et al. [submitted to JGR, 2021]. In this study, we detected three events of simultaneous observation of IPAs and plasma and electromagnetic variations in the magnetospheric source region of IPAs by using an all-sky camera at Kapuskasing, Canada, and the Van Allen Probes satellites. As a result, when the footprints of the Van Allen Probes satellites passed over IPAs, isolated EMIC waves were observed by the satellites (March 22, April 22, and September 7, 2018). All events were observed during geomagnetically quiet times. The equatorward boundaries of the EMIC waves correspond to the increase of the proton flux at energies of ~10 keV, and the flux was predominantly perpendicular to the magnetic field lines. On the other hand, the poleward boundaries of the EMIC waves correspond to the region where the local plasma density began to decrease rapidly. These characteristics were common to all events. Based on these results, we will discuss possible cause of localization of IPA and EMIC waves in the magnetosphere.

Keywords: isolated proton aurora, EMIC wave

